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Abstract

**GAS PHASE METHODS OPERATING AT ATMOSPHERIC PRESSURE FOR THE ANALYSIS
OF SOFT β -EMITTING ISOTOPES**
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For the measurement of radioactivity of organic compounds labelled with soft β -emitting isotopes (^3H , ^{14}C , ^{35}S) almost exclusively gas counting and/or liquid scintillation methods are employed at present. The most exact analysis can be carried out in proportional region with the aid of an internal gas counter reported by Bernstein and Ballentin. However, filling of such counters requires cumbersome and expensive vacuum systems being.

In our Laboratory an effort has been made to eliminate these difficulties accompanying the traditional analysis of radionuclides of labelled organic compounds by elaborating simple new methods operating exclusively at atmospheric pressure instead of using vacuum lines. This could be achieved by adapting suitably constructed counter systems to the classical combusting methods of organic microchemical analysis. To obtain highly precise results for activity the method of choice must meet the following conditions:

1/ Radionuclides to be analysed must be transformed into simple gaseous compounds possessing favourable properties for proportional counting.

2/ Gases being counted must be chemically indifferent and their radioactive constituents must not show any isotopic exchange under conditions applied.

3/ In order to avoid any loss in activity owing to isotope effects, or cross contamination between samples quantitative processes can be employed for all the chemical transformations.

4/ Activity results must be referred to weighed quantities of original compounds instead to the volume of gas being measured.

On the basis of these general principles simple, new methods have been developed for the quantitative determination of

- a/ tritium in form ethane- ^3H
- b/ radiocarbon in form of carbon dioxide- ^{14}C
an/or methane- ^{14}C
- c/ radiosulphur in form of hydrogen sulphide- ^{35}S

Accomplishment of analyses requires only some practice in organic microanalysis.

In all of these processes gases to be measured are frozen out in a small, suitably constricted trap built together with the counter. The anode is tungsten wire of 0,03 mm diameter, the cathode is of stainless steel and/or brass in case of the analysis of ^3H or ^{14}C but of aluminium in case of the analysis of H_2^{35}S . The effective volume of the counters is about 50 ml.

In case of the measurement of $^{14}\text{CO}_2$ and/or H_2^{35}S the filling gas is quantitatively swilled into the sensitive volume of the counter, permitting about 96-98% counting efficiency. However, in case of measurement of methane- ^{14}C and/or ethane- ^3H -ethylene mixture the filling gas is distributed between the sensitive volume of the counter and the volume of the trap. Therefore, these counters are operating with somewhat lower /about 86-88%/ counting efficiency. In all cases excellent characteristic curves could be obtained. The error of reproducibility was found to be less than $\pm 0,5\%$ relative.

Absolute counting rates can also be measured by suitably constructed counters.

The counters can easily be decontaminated by flushing out with flowing gas for about 5 minutes. Any increase of background or other "memory effect" have not been observed.

Further details of our counting technique will be discussed.